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(71)Applicant : MAIKUROFERU KK

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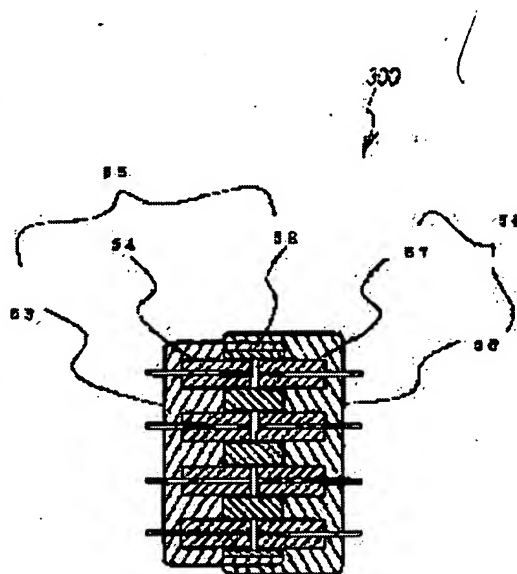
(72)Inventor : KUBOTA SHIGEO
TANAKA TETSUO

(54) FERRULE GUIDE, METHOD FOR MANUFACTURING THE SAME, APPARATUS USED FOR THE MANUFACTURING, AND OPTICAL FIBER CONNECTOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a small and inexpensive ferrule guide capable of connecting a plurality of ferrules and an optical fiber connector provided with the ferrule guide.

SOLUTION: The housing 53 of the receptacle 55 of an optical fiber connector 300 is provided with the ferrule guide 52. When a plug 58 is connected to the receptacle 55, the tip of the ferrule of the plug 58 is inserted into the ferrule insertion hole of the ferrule guide 52. A ferrule 54 at the side of the receptacle 55 and a ferrule 57 on the plug 58 side are butted in the ferrule insertion hole of the ferrule guide 52, and optical fibers mounted to the ferrules 55 and 57 are connected with each other. The ferrule guide 52 can be manufactured highly precisely and at a low cost by electroforming, and the number of components of the optical fiber connector can be reduced because it is small.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the multi-core optical connector which equips a detail with the metal coupling parts and it which are manufactured by electrocasting further, and the equipment used for the manufacture approach and manufacture in coupling parts at a list about an optical connector equipped with the coupling parts for connecting two or more ferrules, and it.

[0002]

[Description of the Prior Art] A cross section holds optical fiber 2a and 2b with a diameter of about 0.13mm to high degree of accuracy in a perfect circle form in a predetermined location, and the conventional optical connector consists of tubular parts (henceforth a ferrule) 1a and 1b for fixing in the shape of the same axle, and the alignment section (sleeve holder) 3 which compares and holds Ferrules 1a and 1b, as shown in drawing 1 (A).

[0003] The ferrule 1 (1a, 1b) has the shape of a cylindrical shape as shown in drawing 1 (B), and is manufactured from zirconia ceramics etc. The ferrule 1 shown in drawing 1 (B) is a 1 alignment (single alignment) type ferrule, for example, the breakthrough 2 of a $\phi 0.126\text{mm}$ perfect circle is formed in the core of a cylinder with a die length of about 8mm along the die-length direction. The sleeve 3 which holds [they compare them and] and aligns Ferrules 1a and 1b at drawing 1 (C) was shown. In order to raise the fitting nature of the comparison alignment precision of Ferrules 1a and 1b, and a sleeve, as shown in drawing 1 R> 1 (C), it divides into a sleeve 3, and the slot is formed in it.

[0004] In order to have manufactured the ferrule as shown in drawing 1 (A), the following approaches were adopted conventionally. first, the object for the injection molding for using mixture of zirconia powder and resin as a raw material, and casting a cylindrical shape or extrusion molding -- public funds -- it casts to a cylindrical shape using a mold etc., a biscuit and a baking process are acquired, and a cylinder-like baking object is produced. To the breakthrough of the acquired cylindrical baking object, the bore of a breakthrough is finely tuned through a linear diamond polish object. It finishes so that the outside of a cylinder object may be machined centering on an inner hole and it may finally become a perfect circle.

[0005] In the above-mentioned molding approach, since the calcinated molding object was contracted a little by baking, a desired bore or a desired dimension might not be obtained. For this reason, polish of the breakthrough using the diamond polish object after baking was indispensable processing. However, this polish is an activity which time and effort is taken and requires skill, and was reducing productivity remarkably. moreover, the diamond in a linear polish object is attached and condition is uneven -- etc. -- even if ground for the reason, it was not easy to make thoroughly the bore in the shaft-orientations location of the inner hole of a baking object into homogeneity. Moreover, the diamond polish object had the problem of causing the jump of a production cost, in order to exhaust.

[0006] Moreover, the special briquetting machine and the metal mold of dedication are required of manufacture of the baking object by the above molding. Since wear of a briquetting machine and metal mold is remarkable in order to use very hard zirconia powder especially, the life of a production facility is also short. Although hard construction material can also be used for a briquetting machine and a metal mold front face, the manufacturing cost of those special briquetting machines and metal mold becomes very high. If the manufacturing cost of a ferrule becomes high as mentioned above, the manufacturing cost of the optical connector which holds it will become high similarly.

[0007] Furthermore, although the 1 alignment (single alignment) type ferrule as [shown in (B) of drawing 1] occupied the mainstream conventionally, in order to let two optical fibers as gradually shown in drawing 3 pass, the ferrule of 2 alignment type with which two breakthrough 2a and 2bs were punched, or the multi-core type ferrule beyond it is required. however, in the ferrule of the type of two or more alignments, it is based on a diamond polish object -- polish dimension appearance was carried out, and the process was dramatically difficult and was not able to manufacture

substantially by the type of three or more alignments.

[0008] Then, the optical connector as shown in drawing 2 is commercialized as an optical connector for the multi-core for connecting two or more optical fibers. Two or more arrays of the basic structure for single alignments which consisted of 1 alignment type Ferrules 1a and 1b and sleeves 3 are carried out, and this optical connector 6 is constituted, as shown in drawing 2 . That is, while two or more arrangement of the 1 alignment type plug side ferrule 1a is carried out into the optical connector 6 plug housing 4, in the jack housing 5, two or more arrangement is carried out and 1 alignment type jack side ferrule 1b and a sleeve 3 are constituted so that it may correspond to it. However, since the optical connector for these multi-core had prepared two or more basic structures for single alignments according to the number of the optical fibers to connect, it had the problem of enlarging while components mark increase as the number of an optical fiber increases.

[0009]

[Problem(s) to be Solved by the Invention] In order to solve this problem, the small multi-core optical connector by resin molding as shown in drawing 4 is commercialized. This multi-core optical connector has the ferrules 7a and 7b made of resin of a couple for multi-core, and the flat spring 11 for concluding these ferrules 7a and 7b, as shown in drawing 3 . The pin hole 10 for positioning for the ferrule made of resin for multi-core to perform positioning of the hole 8 along which the tape fiber core wire 13 passes, and the tape fiber core wire 13 is formed, and the location of tape fiber core wire is determined by inserting a locator pin 9 in the pin hole 10 for positioning of a mutual ferrule.

[0010] The multi-core optical connector made of this resin is manufactured by injecting resin using the metal mold which consists of metal mold 17 when shown in drawing 5 , and a Shimokane mold 12. As shown in drawing 5 , the tape fiber 13 is formed in metal mold, and it passes through the inside of the top metal mold 17, and the tape fiber 13 is held with the maintenance hole 14 of the Shimokane mold 12, and aligns. Moreover, the pin 15 for forming the gage pin hole of the ferrule made of resin cast is inserted so that it may project with a predetermined dimension in space 18 from the pin hole 16 of the Shimokane mold 12. The ferrule made of resin is cast by carrying out injection restoration of the resin fused in the space 18 formed by concluding the top metal mold 17 and the Shimokane mold 12. Since it is necessary to design metal mold to high degree of accuracy in consideration of the flow of the resin at the time of injection molding, or contraction in order to manufacture the ferrule made of this resin, a very highly precise processing technique is needed. So, it was difficult to manufacture the multi-core optical connector of high performance by low cost using the resin casting method. Moreover, the location precision between fibers might fall by the flow of the resin within metal mold, or contraction. Lowering of this location precision caused lowering of an optical transmission property, and was reducing the engine performance as an optical connector remarkably.

[0011] By the way, in the international disclosure number WO 00/31574, this invention persons made the metal deposit on the perimeter of a wire rod by electrocasting, formed the rod-like electrocasting object, and indicated the approach of manufacturing a ferrule, by removing a wire rod from a electrocasting object. The ferrule obtained by this approach is controlled by high degree of accuracy very uniformly [a bore] in shaft orientations. So, the manufacture approach of the ferrule by electrocasting attracts attention as an approach of replacing with the aforementioned molding approach.

[0012] However, also when the optical connector for multi-core was manufactured using the ferrule obtained by this approach, according to the number of the optical fibers to connect, two or more sleeve holders needed to be formed as usual. For this reason, the problem of enlarging while components mark increase as the number of an optical fiber increases was not solved.

[0013] This invention is made in order to solve the problem of the above-mentioned conventional technique, it is small and the object is in the thing equipped with the small coupling parts (henceforth a ferrule guide) and small it which can connect two or more ferrules equipped with the optical fiber for which an optical connector with few components mark is offered.

[0014] Another object of this invention is to offer the equipment used for the manufacture approach for manufacturing a ferrule guide small [above-mentioned] by low cost, and its manufacture.

[0015]

[Means for Solving the Problem] If the 1st mode of this invention is followed, it is a multi-core ferrule guide for connecting two or more ferrules, and it will have the body section formed in one with the metal, and the ferrule guide characterized by carrying out two or more formation of the ferrule insertion hole for inserting a ferrule in the above-mentioned body section will be offered.

[0016] The ferrule guide of this invention has the body section formed in one with the metal, and two or more formation of the ferrule insertion hole with which the ferrule for single alignments (henceforth a single alignment ferrule) is inserted is carried out at the body section. Two or more ferrule insertion holes have a slightly bigger bore than the diameter of a single alignment ferrule, and they are formed in the body section so that the shaft of these holes may be

parallel mutually. Two or more ferrule insertion holes formed in the body section may be formed at intervals of arbitration, even if it is mutually formed regularly at fixed spacing. By inserting the single alignment ferrule equipped with the optical fiber from the ends of the ferrule insertion hole of this ferrule guide, respectively, a ferrule can be aligned in the shape of the same axle within a ferrule insertion hole, and, thereby, the optical fibers with which the single alignment ferrule was equipped can be compared to high degree of accuracy.

[0017] Unlike the ferrule for multi-core which combines the optical fiber itself according to an individual, the ferrule guide of this invention can combine the single alignment ferrules equipped with the optical fiber according to an individual. In order to connect optical fibers and to make low reflection loss in a part for a connection, connection which compares the head of an optical fiber mutually, and the so-called physical contact (henceforth PC) connection are made. For PC connection, generally, where a ferrule is loaded with an optical fiber, the end face of a ferrule was ground to an optical fiber head and coincidence at the convex spherical surface or the slanting convex spherical surface, and processing which grinds to a flat side or a slanting flat side was performed. This PC polish was difficult, in the case of the ferrule for multi-core, when an optical fiber was connected, there was a possibility that reflection loss might become high, but the ferrule guide of this invention becomes possible [connecting the ferrule which carried out PC polish], in order to connect a single alignment ferrule according to an individual, and it is realizable of connection of low reflection loss.

[0018] Moreover, in case the ferrule guide of this invention is manufactured with electroforming which is later mentioned since the appearance does not need to be processed into high degree of accuracy, it does not have the need of controlling strictly the electrocasting layer made depositing on the perimeter of a wire rod. Therefore, manufacture becomes possible for high productivity and a manufacturing cost can be reduced.

[0019] The ferrule guide of this invention can be equipped with at least two pin holes for inserting a pin (guide pin) in the body section in addition to a ferrule insertion hole. Two pin holes are formed in the body section of a ferrule guide so that it may become fixed spacing parallel to the medial axis of a ferrule insertion hole and. The ferrule guide with a pin hole is incorporated in one housing 60 of an optical connector, as shown in drawing 14 . In this case, the pin holes 66a and 66b for inserting pins 62 and 68 are formed in the housing 64 of another side. Pins 62 and 68 are inserted in the pin hole of the ferrule guide 59 built into one housing 60, and if it is made to connect, making housing 60 and 64 guide by the pin, while becoming possible to connect these housing 60 and 64 easily, the ferrules 61 and 65 with which each housing 60 and 64 is equipped, respectively can be certainly drawn in the ferrule insertion hole of the ferrule guide 59.

[0020] The above-mentioned pin may be beforehand prepared in the pin hole of a ferrule guide. In this case, what is necessary is just to form the pin hole for inserting a pin hole in one side. The same thing as the wire rod for pin hole formation used when a ferrule guide was manufactured for example, with electroforming which is mentioned later can be used for this pin. Or when a ferrule guide is manufactured with electroforming, it can leave as it is, without removing the wire rod used for pin hole formation from a electrocasting object, and it can also be formed as a pin. Thus, when using as a pin the wire rod which it left to the electrocasting object, only predetermined die length (for example, one half extent) should extrude a wire rod from the pin hole of the body section of a ferrule guide. The head of a pin may be processed in the shape of a taper, in order to make easy insertion to the pin hole of a ferrule guide. Moreover, two pin holes formed in a ferrule guide can also be formed with a mutually different bore. Thereby, since reverse connection of an optical connector is prevented, the ferrules arranged in predetermined sequence can prevent connecting in order of objection.

[0021] In the ferrule guide of this invention, a pin hole may be formed so that it may be located in the both sides of two or more ferrule insertion holes which aligned for example, at intervals of predetermined, and were formed. The groove in alignment with shaft orientations can be formed in the wall which forms a ferrule insertion hole and a pin hole. Or a groove may be formed so that it may become slanting to the shaft of a ferrule insertion hole and a pin hole. Thereby, the attachment and detachment to the ferrule insertion hole of a ferrule and the attachment and detachment to the pin hole of a pin become easy.

[0022] If the 2nd mode of this invention is followed, an optical connector equipped with the ferrule guide according to the 1st mode of this invention and housing for holding this ferrule guide will be offered.

[0023] Since the optical connector of this invention is equipped with the ferrule guide of the 1st mode of this invention, it is small and its components mark are cheap few. Housing of an optical connector may function as a plug or a jack.

[0024] The ferrule guide built into the optical connector of this invention can be carried out to the ferrule guide which has a pin hole. The ferrule guide with which this pin hole was formed is built into one housing of housing of the couple which constitutes an optical connector as mentioned above. Attachment and detachment of housing are easy for this optical connector, and since it is combined on the basis of a pin, it can align two or more optical fibers extremely at the predetermined spacing at high degree of accuracy, and can be connected.

[0025] An optical connector can be further equipped with the electric terminal for connecting an electric wire. An electric terminal can be constituted using the already known electrical connection terminal, for example, can consist of a pin and a socket. For example, a pin and a socket are prepared in housing which constitutes an optical connector, respectively, and when housing is combined, they can be constituted so that a pin may be held in a socket. An optical connector equipped with an electric terminal can perform simultaneously not only optical communication but electrical communication.

[0026] If the 3rd mode of this invention is followed, it is the manufacture approach of the ferrule guide used for connection of two or more ferrules, and a metal will be made to deposit on the perimeter of at least two wire rods separated at the predetermined spacing by electrocasting, a electrocasting object will be formed, and the manufacture approach of a ferrule guide including removing a wire rod from this electrocasting object will be offered.

[0027] The manufacture approach of this invention is the optimal as an approach for manufacturing the ferrule guide of this invention. By the manufacture approach of this invention, make two or more wire rods which have first the ferrule connected by the ferrule guide, a diameter of said, or a slightly big path arrange so that it may be parallel at the predetermined spacing mutually, a metal is made to deposit on the perimeter of each wire rod by electrocasting, and a rod-like electrocasting object is produced. Subsequently, after cutting the electrocasting object of the shape of an acquired rod in a desired dimension, it removes by a solvent's removing the wire rod inside a electrocasting object, drawing out, or extruding. The electrocasting object with which two or more formation of the breakthrough almost equal to the outer diameter of a ferrule was carried out by this, i.e., a ferrule guide, is acquired. By using such electroforming, a small multi-core ferrule guide can be manufactured by low cost. Moreover, since the metal ferrule guide obtained by electroforming has the inner hole where linearity is high, the polish activity for securing the dimensional accuracy of the bore of a ferrule is unnecessary.

[0028] As for the wire rod for forming a ferrule insertion hole, in the manufacture approach of this invention, it is desirable to use a wire rod with a circular cross section. The diameter of a wire rod is almost equal to the outer diameter of a ferrule, or its slightly large thing is desirable, and it can be suitably chosen according to the outer diameter of the ferrule used for connection. Moreover, the number of the wire rod used in the case of electrocasting is suitably chosen according to the number of the ferrules connected by the ferrule guide.

[0029] What is necessary is just to use two kinds of wire rods of the wire rod for forming the wire rod and ferrule insertion hole for forming a pin hole as a wire rod for making a metal electrodeposit in this invention, when manufacturing a ferrule guide with a pin hole. The wire rod for pin hole formation and the wire rod for fiber hole formation may be paths which are different even if it is a diameter of said.

[0030] It is the wire rod means for supporting which will be used when manufacturing the ferrule guide for connecting two or more ferrules by electrocasting if the 4th mode of this invention is followed, and it is at least two wire rods and the supporter material of the couple which countered mutually and was prepared, and the equipment characterized by including the supporter material for supporting so that parallel may arrange the above-mentioned wire rod of each other [respectively predetermined spacing] is offered.

[0031] The equipment of this invention is effective as equipment used in case the ferrule guide according to the 1st mode of this invention is manufactured by electrocasting. When manufacturing the ferrule guide for for example, four alignments, the supporter material of wire rod means for supporting can be constituted using 4 sets of rods 41a-41d, as shown in drawing 11 . 4 sets of rods 41a-41d have an outer diameter mutually different, respectively, and they are laid so that it may counter on a substrate 42. And as shown in drawing 11 , each wire rod 39 is arranged by parallel at spacing which is mutually different to a substrate 42 on a substrate 42 by making Rods 41a-41d support four wire rods 39 for forming a ferrule insertion hole, respectively. By changing the outer diameter of each rod suitably, spacing of a wire rod can be adjusted to high degree of accuracy. In this way, the wire rod stretched by parallel at the predetermined spacing aligns so that it may be contained by the wire rod alignment member in the same side. By improving these wire rod means for supporting, the ferrule guide which has two pin holes is producible. In this case, what is necessary is to prepare separately the wire rod for pin holes for forming a pin hole, to make the wire rod for pin holes support by supporter material, and just to perform electrocasting with the wire rod for ferrule insertion holes. What is necessary is to reduce suitably the supporter material which supports the wire rod for forming a ferrule insertion hole, and it to wire rod means for supporting, or just to add to them, when producing the ferrule guide of two alignments, three alignments, and six alignments. For example, what is necessary is just to support six wire rods using 6 sets of rods with which outer diameters differ mutually that what is necessary is just to support two wire rods using 2 sets of rods with which outer diameters differ mutually in 2 alignment ferrule guide in the ferrule guide of six alignments.

[0032] Moreover, supporter material can also consist of plates with which two or more slots were formed in one side as shown in drawing 12 at the predetermined spacing. A slot can be used as for example, a V character mold or a U

character mold. Each Mizogami formed in the plate can be made to arrange each wire rod of each other at the parallel and predetermined spacing by arranging a wire rod. Spacing of wire rods is controllable by this supporter material by adjusting spacing (pitch) of a slot. Moreover, the cylinder member in which the slot which supports not only a plate but a wire rod was formed can be used for supporter material. In this case, even if selectively formed in the cylindrical periphery, the slot may be formed so that it may go around.

[0033]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the ferrule guide according to this invention and its manufacture approach is concretely explained using a drawing.

[0034]

[Example 1] The outline block diagram of the ferrule guide for 4 alignments was shown as an example of the ferrule guide which follows this invention at drawing 6. Moreover, the outline block diagram of the ferrule guide for 8 alignments was shown in drawing 7 as another example. As for 4 alignment ferrule guide 19 shown in drawing 6, the ferrule insertion holes 20a-20d with which a ferrule is inserted in body section 19a are formed. Body section 19a has the periphery section of the ferrule insertion holes 20a-20d and the same axle for every ferrule insertion hole. On the other hand, 8 alignment ferrule 21 shown in drawing 7 has body 21a of the prism configuration where an angle is round, and eight ferrule insertion holes 22 with which a ferrule is inserted, respectively are punched at body 21a. Body 21a has the periphery section of each ferrule insertion hole 22 and the same axle for every ferrule insertion hole.

[0035] The multi-core ferrule guide shown in drawing 6 and drawing 7 is produced using electrocasting equipment as shown in drawing 10. Electrocasting equipment is equipped with the anode plate 33 and cathode 34 which have been arranged in the electrocasting bath 31, and the electrocasting liquid 32 with which it filled up in the electrocasting bath 31 and the electrocasting bath 31. On the base 35 installed in the pars basilaris ossis occipitalis, the anode plate 33 is formed so that cathode 34 may be surrounded. The core wire 38 used as the electrocasting matrix stretched by wire rod means for supporting as shown in cathode 34 by drawing 11 is attached by fixed tension by the spring 36 grade between the vertical edges of the core-wire support fixture 37. Core wire 38 is electrically connected to cathode 34. About the wire rod means for supporting for stretching a wire rod, it mentions later. Electrocasting liquid 32 is determined according to the construction material of the metal which is going to electroform around core wire 38, for example, electrocasting metals, such as nickel or a nickel alloy, can be used, and the water solution which uses nickel amiosulfonate, a nickel chloride, a nickel sulfate, etc. as a principal component is used.

[0036] Here, the wire rod means for supporting shown in drawing 11 are explained. The wire rod means for supporting shown in drawing 11 are equipment for electroforming 4 alignment ferrule guide, drawing 11 (A) is the top view of wire rod means for supporting, and drawing 11 (B) is a sectional view when cutting in respect of a wire rod 39 being included in drawing 11 (A). The wire rod means for supporting 101 are equipped with the wire rod 39 for ferrule insertion holes, a substrate 42, a rod 41, the block 44 for alignment, the core-wire holder 45, a tension pulley 43, and the auxiliary members 40a and 40b. A rod 41 consists of four kinds of rods 41a-41d with which paths differ, and is laid on the substrate 42, respectively. The these rods [41a-41d] outer diameter is large in Rods [41a-41d] order. Moreover, as shown in drawing 11 (A) and (B), rod 41a with the smallest outer diameter is arranged inside, and Rods 41b, 41c, and 41d are arranged in order toward the outside.

[0037] The selection activity of the wire rod 39 for ferrule insertion holes is suitably carried out from plastics lines, such as a thing which is a matrix for forming the ferrule insertion hole 20 of the ferrule guide 19 shown in drawing 6, respectively, for example, carried out thin pewter plating metal wires, such as iron or its alloy, aluminum or its alloy, copper, or its alloy, and on this metal wire and nylon, polyester, and Teflon (trademark). Among these, in the case of a plastics line, since electroless deposition, such as nickel and silver, is needed for a front face for conductive grant, it is advantageous to use electroconductive plastics. In this case, if it energizes and heats to electroconductive plastics after electrocasting, drawing mold release of a electrocasting object will become easy. In order that the wire rod 39 for ferrule insertion holes may determine the bore of the ferrule insertion hole of the ferrule guide obtained by electrocasting, according to the outer diameter of a ferrule, the size of a line is chosen suitably. At present, since a ferrule with an outer diameter of 2.5mm and a ferrule with an outer diameter of 1.5mm - 0.9mm exist, the wire rod for ferrule insertion hole formation can also be made into the outer diameter and the diameter of said of these ferrules, and a slightly big path. A line can carry out adjustment of a size, roundness, and linearity by extrusion by the dice, an approach or center loess processing by wire drawing, etc. At present, in the case of a stainless steel line, the stainless steel wire rod product of about ± 0.5 -micrometer error range is available.

[0038] After the wire rod 39 for ferrule insertion holes is supported with Rods 41a-41d while it was twisted around the tension pulley 43 as shown in drawing 11 (B), it is attached in fixed part 40c through the auxiliary members 40a and 40b. The predetermined load W is applied to down among drawing 11 (B), and, thereby, predetermined tension can be

given to a wire rod 39 at a tension pulley 43. Spacing of Z shaft orientations of the wire rod 39 for ferrule insertion holes can be adjusted to high degree of accuracy among drawing 11 (B) by changing each rods [which are supporting the wire rod / 41a-41d] outer diameter.

[0039] The block 44 for alignment can put a wire rod 39 by the predetermined force F in Y shaft orientations among drawing 11 R> 1 (A). Thereby, a wire rod 39 can be aligned on an X-Z flat surface. A wire rod 39 is fixed maintaining predetermined spacing using the wire rod attaching parts 45a and 45b of the core-wire holder 45. The holder with which it filled up with resin and adhesives, such as a photo-setting resin and thermosetting resin, can be used for the wire rod attaching parts 45a and 45b of the core-wire holder 45, and a wire rod is fixed to them by making it solidify, where the clearance between wire rods is fill uped with resin or adhesives. Or as wire rod attaching parts 45a and 45b of the core-wire holder 45, using the clip formed from comparatively soft metals, such as copper, a wire rod cannot be inserted and it can also fix mechanically with this clip.

[0040] Next, a wire rod 39 is cut between the alignment block 44 and wire rod attaching part 45a (45b) of the core-wire holder 45. Since the wire rod held by the wire rod attaching parts 45a and 45b of the core-wire holder 45 at this time is restrained in the die-length direction of a wire rod by restricted supporter 45c of the core-wire holder 45, the wire rod 39 stretched by fixed tension bends, and linearity is not spoiled. In this way, the core-wire support fixture of the electrocasting equipment shown in drawing 10 is equipped with the wire rod held by the core-wire holder 45.

[0041] Below, the electrocasting equipment 100 shown in drawing 10 explains the actuation which forms a ferrule guide by electrocasting. After filling up the electrocasting bath 31 with electrocasting liquid 32, DC electrical potential difference is impressed to an anode plate 33 and cathode 34 so that it may become about two 4 - 20 A/dm current density. Thereby, an electrodeposited object can be grown up into the perimeter of a wire rod. A support fixture is taken out from the electrocasting bath 31 after termination of electrocasting, and a wire rod is removed from means for supporting. The obtained electrocasting object is cut by predetermined die length for example, using a thin cutting-edge cutter.

[0042] The wire rod for ferrule holes is removable by melting in the acid or alkali water solution which drew out from the obtained electrodeposited object or was heated etc. What is necessary is just to draw out, heating a metal wire, when the metal wire of pewter plating is used as these wire rods. Moreover, a wire rod can also be taken out by extruding using a superhard pin etc. from an electrodeposited object. In this case, it is desirable to carry out, after melting the end of the wire rod of electrocast products a little with a chemical. What is necessary is just to determine whether the ingredient of the selected wire rod draws out the wire rod which exists in the interior of electrocast products, it extrudes, or it dissolves with a chemical. For example, since a wire rod tends to dissolve a wire rod at an acid or alkali ***** in the case of aluminum or its alloy, copper, or its alloy, clearance by the dissolution is effective. As a solution, the strong-base water solution which hardly affects a electrocasting metal is desirable, dissolving aluminum or its alloy. Strong-base water solutions, such as a sodium hydroxide of about [5-10 w/v%] concentration and a potassium hydroxide, can be used, and, specifically, dissolution clearance can be easily carried out by heating at about 100**3 degrees C. In this way, the ferrule guide shown in drawing 6 is producible.

[0043]

[Example 2] A ferrule guide with a pin hole is shown in drawing 8 and drawing 9 . The ferrule guide shown in drawing 8 is equipped with the pin hole for inserting a pin, it is the ferrule guide of 4 alignment type which can connect four ferrules, and the ferrule guide shown in drawing 9 is a ferrule guide equipped with a pin hole 8 alignment type. The ferrule guide 23 shown in drawing 8 consists of 1st body 23a, 2nd body 23b, and connection section 23c that connects these bodies. The major-diameter pin hole 25 is formed in 1st body 23a, and the minor diameter pin hole 26 is formed in 2nd body 23b. Four ferrule insertion holes 24 are formed in connection section 23c. The bore of the major-diameter pin hole 25 is larger than the bore of the minor diameter pin hole 26. A major-diameter pin and a minor diameter pin are inserted in the major-diameter pin hole 25 and the minor diameter pin hole 26 of a ferrule guide, respectively. These pins can be obtained by leaving the electrocasting inside of the body, without removing the wire rod for pin holes from the electrocasting object acquired by the manufacture approach mentioned later. And it can be made to function as a pin, when only a predetermined dimension projects a wire rod. Thus, components mark can be reduced by using as a pin the wire rod used on the occasion of electrocasting.

[0044] On the other hand, the ferrule guide 27 shown in drawing 9 consists of 1st body 27a, 2nd body 27b, and connection section 27c that connects these bodies. The major-diameter pin hole 29 is formed in 1st body 27a, and the minor diameter pin hole 30 is formed in 2nd body 27b. Eight ferrule insertion holes 28 are formed in connection section 27c.

[0045] The wire rod means for supporting used in order to manufacture the ferrule guide shown in drawing 8 next are explained with reference to drawing 12 . The wire rod means for supporting 200 shown in drawing 12 are equipment for

manufacturing 4 alignment ferrule guide with a pin hole shown in drawing 8 by electrocasting, and are mainly equipped with the wire rod 46 for ferrule insertion holes, the wire rod 47 for minor diameter pin holes, the wire rod 48 for major-diameter pin holes, a support plate 49, and the core-wire holder 50. The wire rod 46 for ferrule holes is a matrix for forming the ferrule insertion hole 24 of the ferrule guide 23 shown in drawing 8. The wire rod 47 for minor diameter pin holes and the wire rod 48 for major-diameter pin holes are the matrices for forming the minor diameter pin hole 26 and the major-diameter pin hole 25 of the ferrule guide 23 of drawing 8, respectively, and the wire rod 47 for minor diameter guide holes consists of wire rods 48 for a major-diameter guide using a wire rod with a small diameter.

[0046] Four V groove 49 for supporting wire rod 46 for ferrule insertion holes a, V groove 49b for supporting the wire rod 47 for minor diameter pin holes, and V groove 49c for supporting the wire rod 48 for major-diameter pin holes are formed in the top face of a support plate 49. V groove 49a is formed between V groove 49b and V groove 49c on the front face of a support plate 49. Moreover, the channel depth or the flute width is adjusted by V grooves 49a, 49b, and 49c so that the medial axis of each wire rod may be in agreement with the front face of a support plate, when wire rods 46, 47, and 48 are laid on V grooves 49a and 49b and 49c, respectively.

[0047] Moreover, as for wire rods 46-48, predetermined tension is given in the die-length direction. For example, the approach of pulling a wire rod in the die-length direction, using elastic members, such as a spring and rubber, as an approach of giving tension to a wire rod, and the approach of fixing the end of a wire rod, and attaching and pulling weight for many items can be used.

[0048] The wire rods 46-48 stretched by predetermined tension are fixed by the wire rod attaching parts 50a and 50b of the core-wire holder 50 at the predetermined spacing. As shown in drawing 12, wire rod attaching part 50a of the core-wire holder 50 consists of superior lamella 50a' and inferior lamella 50a'', and can sandwich wire rods 42-44 by the predetermined force by superior lamella 50a' and inferior lamella 50a''. When a wire rod is inserted into one side of superior lamella 50a' and inferior lamella 50a'' by superior lamella 50a' and inferior lamella 50a'', 50d of heights by which the wire rod for fiber holes is supported is formed in it, and the wire rod 46 for ferrule insertion holes and the wire rods 47 and 48 for pin holes with which diameters differ mutually by this can be inserted by the fixed pressure. In addition, although not illustrated to drawing 12 about the superior lamella and inferior lamella of wire rod attaching part 50b of the core-wire holder 50, it has the same structure and same function as 50a.

[0049] As a means to fix a wire rod with the core-wire holder 50, hardenability resin, adhesives, etc. can be used like the wire rod means for supporting of drawing 8. What is necessary is to slush resin and adhesives between superior lamella 50a' and inferior lamella 50a'', and just to make it solidify, when using hardenability resin and adhesives. Or a core-wire holder can also constitute superior lamella 50a' and inferior lamella 50a'' using metals, such as copper, in this case, when it inserts by superior lamella 50a' and inferior lamella 50a'', can make wire rods 46-48 buried in superior lamella 50a' and inferior lamella 50a'', respectively, and can fix them.

[0050] In the wire rod means for supporting 200 shown in drawing 12, the cylinder object which has two or more circumference slots of the predetermined depth at the predetermined spacing may be used instead of a support plate 49. In this case, what is necessary is to make each circumference slot support a wire rod, and just to constitute.

[0051] The wire rods 46-48 supported as shown in drawing 12 are cut between a support plate 49 and wire rod attaching part 50a (50b) of the core-wire holder 50. Since the wire rod held by the wire rod attaching parts 50a and 50b of the core-wire holder 50 at this time is restrained in the die-length direction of a wire rod by restricted supporter 50c of the core-wire holder 50, the wire rod stretched by fixed tension bends, and linearity is not spoiled. The core-wire support fixture of the electrocasting equipment shown in drawing 10 is equipped with the wire rod held by the core-wire holder 50, and the ferrule guide shown in drawing 8 can be obtained by performing electrocasting like an example 1.

[0052] Although wire rod means for supporting as shown in drawing 12 were used in this example as wire rod means for supporting used in order to manufacture the ferrule guide which has a pin hole as shown in drawing 8, it can do also by being manufacturing using the wire rod means for supporting which improved the wire rod means for supporting used in the example 1. Namely, what is necessary is to arrange the 6th supporter with an outer diameter smaller than the 4th supporter inside the 4th supporter, and just to make it support the wire rod for pin hole formation by predetermined tension with the 5th supporter and the 6th supporter in the wire rod means for supporting shown in drawing 11, while arranging the 5th supporter material with a bigger outer diameter than the 1st supporter on the outside of the 1st supporter. Even if it uses these wire rod means for supporting, the ferrule guide shown in drawing 8 can be manufactured.

[0053]

[Example 3] The optical connector equipped with the ferrule guide for 4 alignments shown in drawing 6 next is explained. The outline block diagram of an optical connector 300 is shown in drawing 1313. As shown in drawing 13, an optical connector 300 consists of an optical fiber receptacle (jack) 55 and an optical fiber plug (plug) 58. The optical

fiber receptacle 55 mainly consists of receptacle housing 53, a ferrule guide 52, and four single alignment ferrules 54. The ferrule guide 52 is held in the receptacle housing 53, and is positioned in the side (drawing Nakamigi side) connected with the optical fiber plug 58 into the receptacle housing 53. Four single alignment ferrules 54 are the interior of the receptacle housing 53, respectively, and these ends are selectively inserted in each ferrule insertion hole of the ferrule guide 52. On the other hand, the optical fiber plug 58 mainly consists of plug housing 56 and four single alignment ferrules 57. The single alignment ferrule 57 is formed in the side connected with the optical fiber receptacle 55 into the plug housing 56 so that the other end may project selectively from the plug housing 56. The plug housing 56 and the receptacle housing 53 are manufactured by injection molding.

[0054] If the optical fiber plug 58 is connected with the optical fiber receptacle 55 as shown in drawing 13, the head of the single alignment ferrule with which the optical fiber plug 58 is equipped will be inserted in each ferrule insertion hole of the ferrule guide 52 of the optical fiber receptacle 55. That is, the single alignment ferrule 54 prepared in the optical fiber receptacle 55 and the single alignment ferrule 57 prepared in the optical fiber plug 58 are compared within the ferrule insertion hole of the ferrule guide 52, and the optical fiber of each other with which these single alignment ferrule is equipped is connected.

[0055]

[Example 4] This example explains an optical connector equipped with the ferrule guide for 4 alignments with a pin hole shown in drawing 8. The outline block diagram of the optical connector 400 which equips drawing 14 with this ferrule guide is shown.

[0056] As shown in drawing 14, an optical connector 400 consists of an optical fiber receptacle 63 and an optical fiber plug 67. The optical fiber receptacle 63 is equipped with the single alignment ferrule 61 of 60 or 4 receptacle housing, the ferrule guide 59, the major-diameter pin 62, and the minor diameter pin 68. The ferrule guide 59 is positioned in the side linked to an optical fiber plug within the receptacle housing 60. The major-diameter pin 62 and the minor diameter pin 68 are held in the major-diameter pin hole and minor diameter pin hole of the ferrule guide 59, respectively, and are held. The major-diameter pin 62 and the minor diameter pin 68 are obtained by leaving without removing the wire rod used in order to form a major-diameter pin hole and a minor diameter pin hole from a electrocasting object, i.e., a ferrule guide, in case a ferrule guide is manufactured. That is, the wire rod for major-diameter pin hole formation and the wire rod for minor diameter pin hole formation can be used as the major-diameter pin 62 and a minor diameter pin 68, respectively, when only predetermined die length extrudes from the major-diameter pin hole and minor diameter pin hole of a ferrule guide. As for four single alignment ferrules 61, the end is inserted in the ferrule insertion hole of the ferrule guide 59 according to an individual.

[0057] An optical fiber plug is equipped with the plug housing 64 and four single alignment ferrules 65. As shown in the plug housing 64 at drawing 14, the pin insertion holes 66a and 66b are formed. The pin insertion holes 66a and 66b can insert the major-diameter pin 62 and the minor diameter pin 68 with which the optical fiber receptacle 63 is equipped, respectively, when the optical fiber plug 67 is connected with the optical fiber receptacle 63.

[0058] In order to connect the optical fiber plug 67 with the optical fiber receptacle 63, the major-diameter pin 62 and the minor diameter pin 68 of the optical fiber receptacle 63 are inserted in the pin insertion holes 66a and 66b currently formed in the optical fiber plug 67, respectively. Since the major-diameter pin 62 and the minor diameter pin 68 are formed with a mutually different outer diameter, it is prevented that the optical fiber receptacle 63 and the optical fiber plug 67 are connected to the reverse sense. Moreover, since it is connected with an optical fiber receptacle, the optical fiber plug 67 being guided to the pins 62 and 68 of the optical fiber receptacle 63, attachment and detachment are easy and the ferrule of the optical fiber plug 67 can be certainly connected to the ferrule insertion hole of the ferrule guide 59 prepared in the optical fiber receptacle according to an individual.

[0059]

[Example 5] 4 alignment ferrule guide with which it divided into the ferrule insertion hole, and the slot was formed in drawing 15 (A) as an example of amelioration of the ferrule guide shown in drawing 6 is shown. The ferrule guide shown in drawing 15 (A) is broken so that it may be open for free passage with a hole in the wall which forms the ferrule insertion hole 69, and the slot 71 is formed. This rate slot 71 is formed by carrying out cutting of the wall which forms a ferrule insertion hole to parallel to the shaft of a ferrule insertion hole with NC machine machining machine, after removing the wire rod for ferrule insertion holes from the electrodeposited object obtained by electrocasting, respectively. A rate slot can also be aslant formed to the shaft of a ferrule insertion hole. A single alignment ferrule with an optical fiber can be inserted in the ferrule insertion hole in which this rate slot was formed very easily.

[0060] Moreover, as shown in drawing 15 (B), it can divide also into the ferrule insertion hole 73 of the ferrule guide 72 with which the pin holes 175 and 176 were formed, and a slot 74 can be formed. Moreover, in the ferrule guide 72 shown in drawing 15 (B), it can divide also into the pin holes 175 and 176, and a slot can be formed. It becomes

possible by dividing into a pin hole and forming a slot to make it equip with a pin easily.

[0061]

[Example 6] The connector (henceforth a photoelectricity compound connector) of the photoelectricity compound die which can perform optical communication and electrical communication simultaneously is shown in drawing 16. The photoelectricity compound connector 500 consists of a receptacle 78 and a plug 82. The receptacle 78 and the plug 82 have the optical connector sections 91 and 93 for making optical fiber connection, and the electrical connector sections 92 and 94 for connecting an electric wire, respectively.

[0062] As shown in drawing 16, a receptacle 78 consists of the receptacle housing 75, the ferrule guide 74, a pin 77, 77', and a ferrule 76 and the receptacle contact (socket terminal) 76. As shown in drawing, the ferrule guide 74, a pin 77, 77', and a ferrule 76 are formed above the receptacle housing 75 as the optical connector section 91. The optical connector section 91 of this receptacle 78 has the same structure and same function as a receptacle 63 of the optical connector 400 shown in drawing 14. On the other hand, under the receptacle housing 75, four receptacle contacts 83 are formed as the electrical connector section 92.

[0063] A plug 82 consists of plug housing 79, a ferrule 80, and pin contact (pin terminal) 84. As shown in drawing, the ferrule 80 and the pin hole with which the pin 77 and 77' which are prepared in the receptacle 78 are inserted are prepared above the plug housing 79 as the optical connector section 93. The optical connector section 93 of this plug 82 has the same structure and same function as a plug 67 of the optical connector 400 shown in drawing 14. On the other hand, under the plug 82, four pin contacts 84 are formed as the electrical connector section 94.

[0064] The electric wire for transmitting an electrical signal etc. is connected to the receptacle contact 83 of a receptacle 78, and the pin contact 84 of a plug 82. Connection of the receptacle 78 and plug 82 of the photoelectricity compound connector 500 shown in drawing 16 inserts the pin contact 84 in the receptacle contact 83. This photoelectricity compound connector can transmit an electrical signal with a lightwave signal.

[0065] As mentioned above, although the example explained concretely the connector equipped with the ferrule guide of this invention, its manufacture approach, and a ferrule guide, this invention is not limited to this and may include various modifications and examples of amelioration. In the above-mentioned example, although the optical connector which holds 4 alignment ferrule was explained, an optical connector can also be constituted using 8 alignment ferrule as shown in drawing 6.

[0066] Moreover, although the ferrule insertion hole with which a ferrule is inserted was formed in the body of a ferrule guide so that it might stand in a line in the shape of a straight line, it is possible to form so that it may stand in a line in the shape of a circle, and to adjust the location of a ferrule insertion hole suitably within a body.

[0067] Moreover, as an optical connector, although the connection interrupt side produced the connector of a square shape, the optical connector which has the connection interrupt side configuration of arbitration, such as a round shape, can also be manufactured.

[0068] Moreover, in the wire rod means for supporting shown in drawing 11, although four kinds of rods 41a-41d were used, the multistage supporter material 180 equipped with 1st outer-diameter section 181a as shown in drawing 17 - the 181d of the 4th outer-diameter sections instead of this rod can also be used. In this case, what is necessary is just to, make the wire rod for ferrule insertion holes support, respectively in the 181d of the 1st outer-diameter section 181a - 4th outer-diameter sections for example.

[0069]

[Effect of the Invention] If two or more single alignment ferrules after PC polish are connected using the ferrule guide of this invention since the ferrule guide of this invention can connect two or more single alignment ferrules equipped with the optical fiber according to an individual simultaneous for example, it can connect the optical fiber with which two or more single alignment ferrules were equipped, respectively by low reflection loss.

[0070] Since the optical connector of this invention is constituted using the ferrule guide of this invention, it is very small and there are also few components mark. So, it is very the optimal as an optical connector for junction.

[0071] Moreover, according to the manufacture approach of this invention, the ferrule guide of this invention can be manufactured easily and cheaply with electroforming.

[0072] If electrocasting is performed using the wire rod which aligned using the wire rod means for supporting of this invention, moreover, the ferrule guide of this invention can be easily manufactured by low cost to accuracy.

[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] The ferrule guide characterized by carrying out two or more formation of the ferrule insertion hole for having the body section which is a multi-core ferrule guide for connecting two or more ferrules, and was formed in one with the metal, and inserting a ferrule in the above-mentioned body section.

[Claim 2] Furthermore, the ferrule guide according to claim 1 characterized by forming the 1st pin hole and the 2nd pin hole for inserting the 1st pin and the 2nd pin for alignment in the above-mentioned body section, respectively.

[Claim 3] The ferrule guide according to claim 2 whose above-mentioned ferrule insertion hole is characterized by carrying out two or more formation between the 1st pin hole and the 2nd pin hole at the shape of an array.

[Claim 4] Furthermore, the ferrule guide according to claim 2 or 3 characterized by having either [at least] the 1st pin or the 2nd pin.

[Claim 5] A ferrule guide given in any 1 term of claims 2-4 characterized by the bores of the 1st pin hole and the 2nd pin hole differing mutually.

[Claim 6] A ferrule guide given in any 1 term of claims 2-5 characterized by dividing parallel or aslant to the shaft orientations of these holes, and forming the slot in the wall surface which is forming the above-mentioned ferrule insertion hole, the 1st pin hole, and the 2nd pin hole.

[Claim 7] It is the ferrule guide according to claim 4 which is the wire rod which the above-mentioned body section was formed of electrocasting, and was used when the 1st pin and the 2nd pin formed a ferrule by electrocasting, respectively.

[Claim 8] The above-mentioned body section is a ferrule guide given in any 1 term of claims 1-7 characterized by having the periphery section of the above-mentioned ferrule insertion hole and the same axle for every ferrule insertion hole.

[Claim 9] An optical connector equipped with a ferrule guide according to claim 3 and housing for holding this ferrule guide.

[Claim 10] The optical connector according to claim 9 whose above-mentioned housing is either a plug and a jack.

[Claim 11] Furthermore, the optical connector according to claim 9 or 10 characterized by having an electric terminal insertion hole for connecting an electric wire.

[Claim 12] The manufacture approach of a ferrule guide including being the manufacture approach of the ferrule guide used for connection of two or more ferrules, making a metal deposit on the perimeter of at least two wire rods separated at the predetermined spacing by electrocasting, forming a electrocasting object, and removing a wire rod from this electrocasting object.

[Claim 13] The manufacture approach according to claim 12 characterized by being a kind chosen from the group which the above-mentioned metal becomes from aluminum, nickel, iron, copper, cobalt, tungstens, and those alloys.

[Claim 14] Equipment which is the wire rod means for supporting used when manufacturing the ferrule guide for connecting two or more ferrules by electrocasting, is at least two wire rods and the supporter material of the couple which countered mutually and was prepared, and is characterized by including the supporter material for supporting so that parallel may arrange the above-mentioned wire rod of each other [respectively predetermined spacing].

[Claim 15] The above-mentioned ferrule guide is equipment according to claim 14 characterized by having two pin holes with which two pins are inserted, respectively, and having the supporter material for supporting two wire rods and this wire rod for forming two pin holes further.

[Claim 16] Furthermore, equipment according to claim 14 or 15 characterized by having a wire rod alignment member for aligning the wire rod supported by the above-mentioned supporter material so that it may be contained in the same side.

[Claim 17] Furthermore, it is equipment given in any 1 term of claims 14-16 which are equipped with the substrate with

which the above-mentioned supporter material is laid, and are characterized by the above-mentioned supporter material supporting the above-mentioned wire rod so that it may be arranged by parallel at spacing from which each wire rod differs mutually to a substrate on a substrate.

[Claim 18] On the above-mentioned substrate with the 1st supporter material which the above-mentioned supporter material is supporter material of the shape of a cylindrical shape of a couple which countered mutually and was established on the above-mentioned substrate, and has the same outer diameter mutually It is the supporter material of the couple which countered mutually and was prepared between the 1st supporter material of a couple. Equipment according to claim 14 characterized by the above-mentioned wire rod being supported by the 1st supporter material and the 2nd supporter material, respectively, including at least the 2nd supporter material which is the same outer diameter mutually and has an outer diameter smaller than the 1st supporter material.

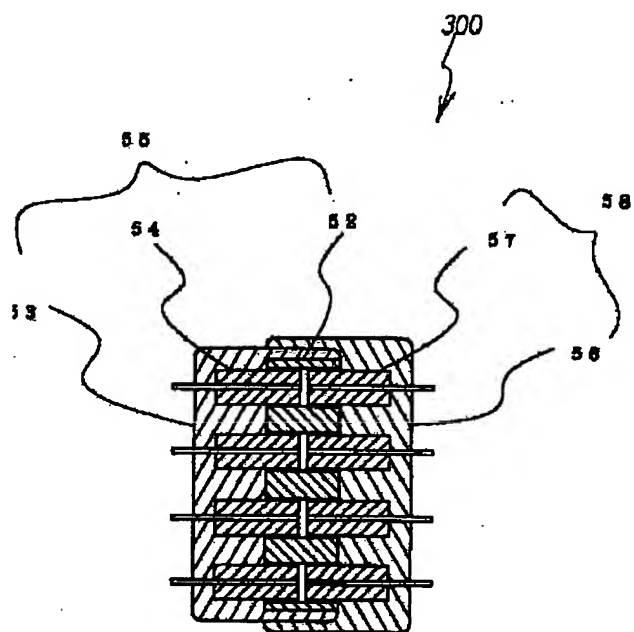
[Claim 19] The above-mentioned supporter material is equipment according to claim 14 characterized by having two or more slots formed at the predetermined spacing, and the above-mentioned wire rod being supported by this slot, respectively.

[Claim 20] The wire rod for forming the above-mentioned pin hole is equipment according to claim 15 characterized by having a different path from the other wire rod.

[Claim 21] Furthermore, equipment given in any 1 term of claims 14-20 characterized by having a holder for fixing the above-mentioned wire rod, with predetermined spacing held.

[Translation done.]

Drawing selection ☒ Representative drawing



[Translation done.]

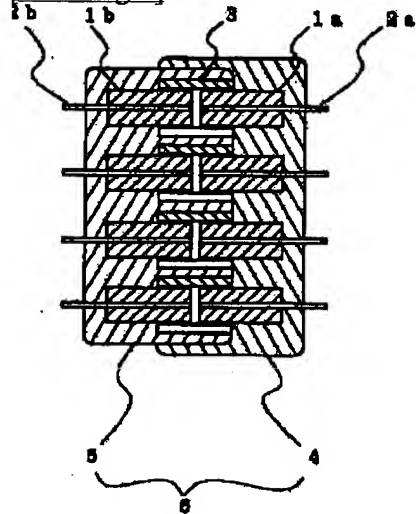
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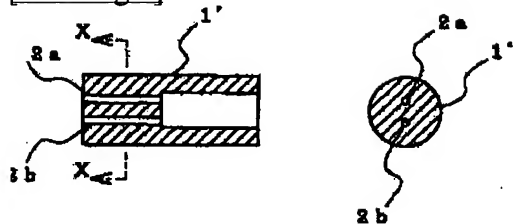
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DRAWINGS

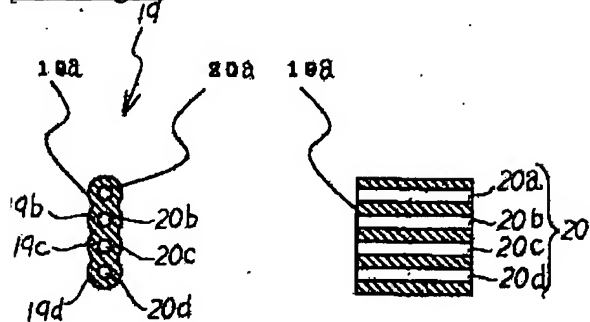
[Drawing 2]



[Drawing 3]

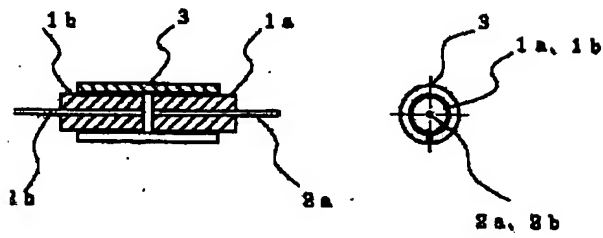


[Drawing 6]

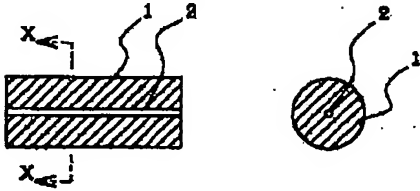


[Drawing 1]

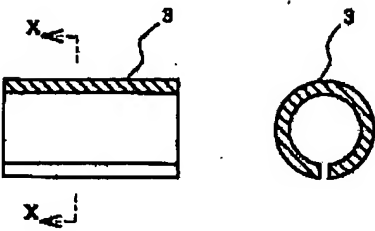
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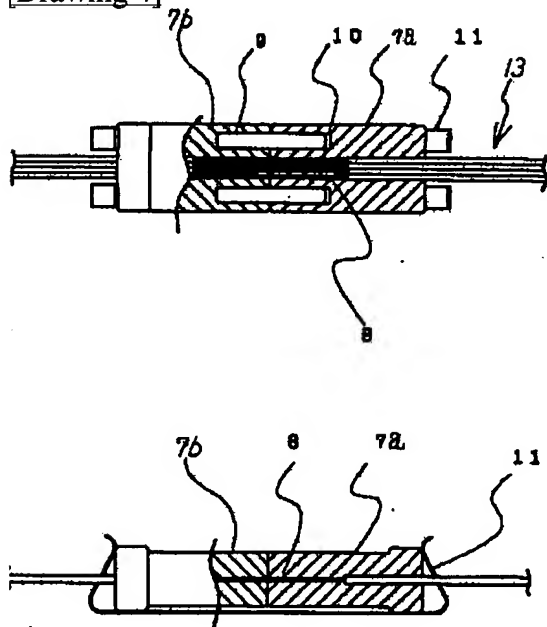
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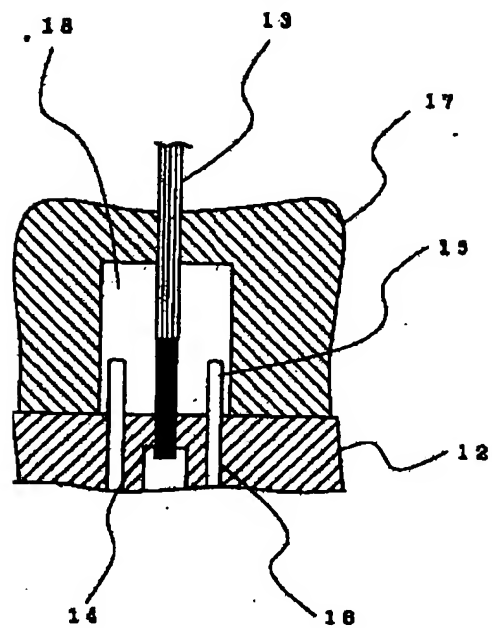
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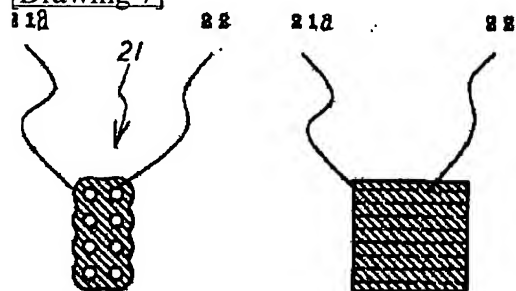
[Drawing 4]



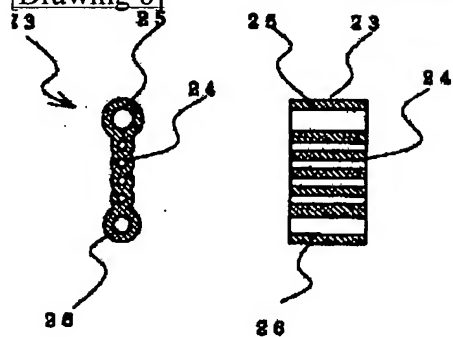
[Drawing 5]



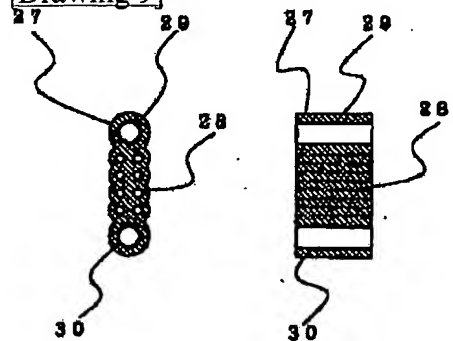
[Drawing 7]



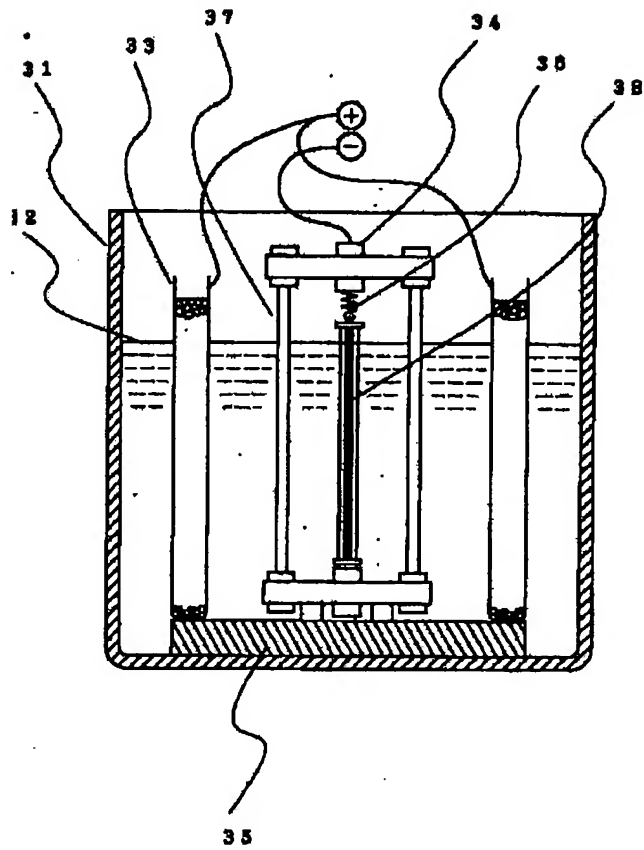
[Drawing 8]



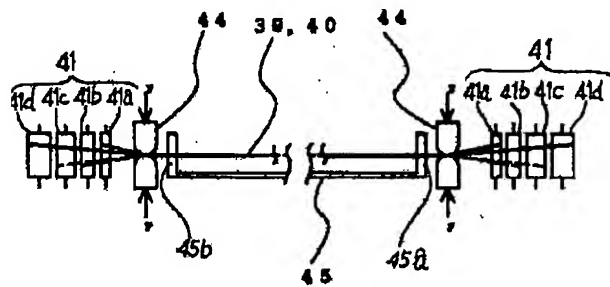
[Drawing 9]



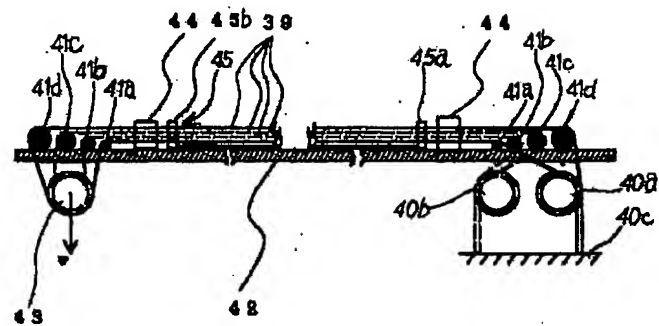
[Drawing 10]



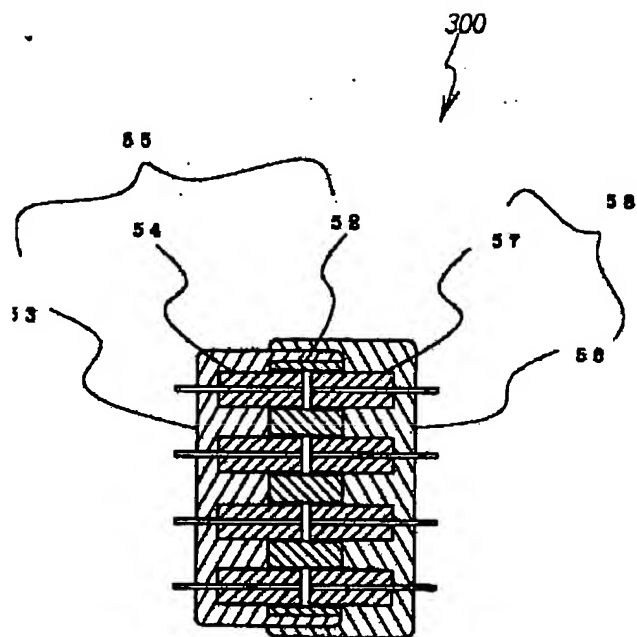
[Drawing 11]
(A)



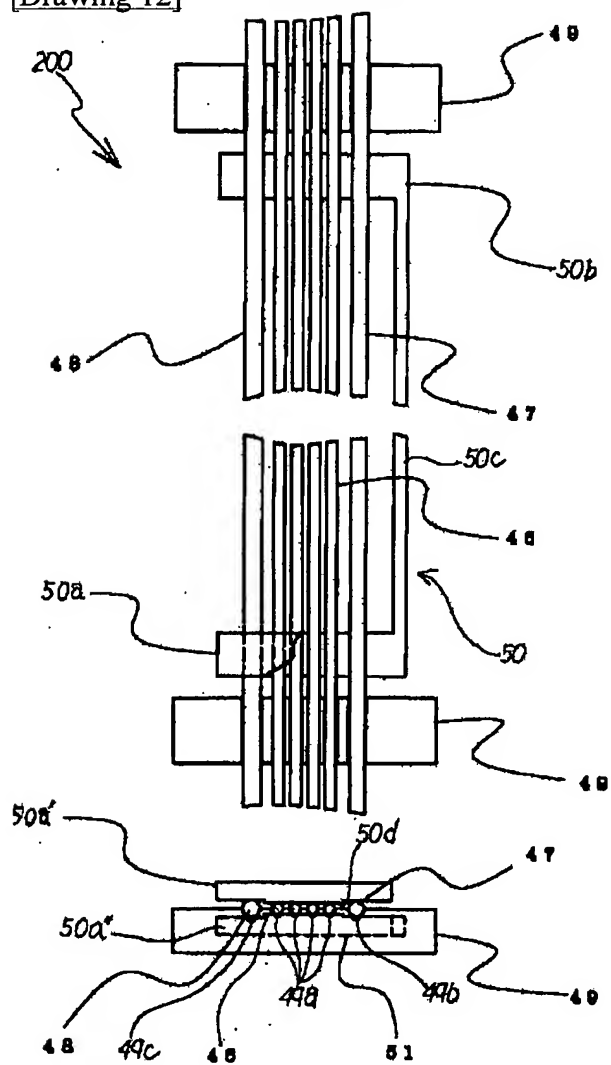
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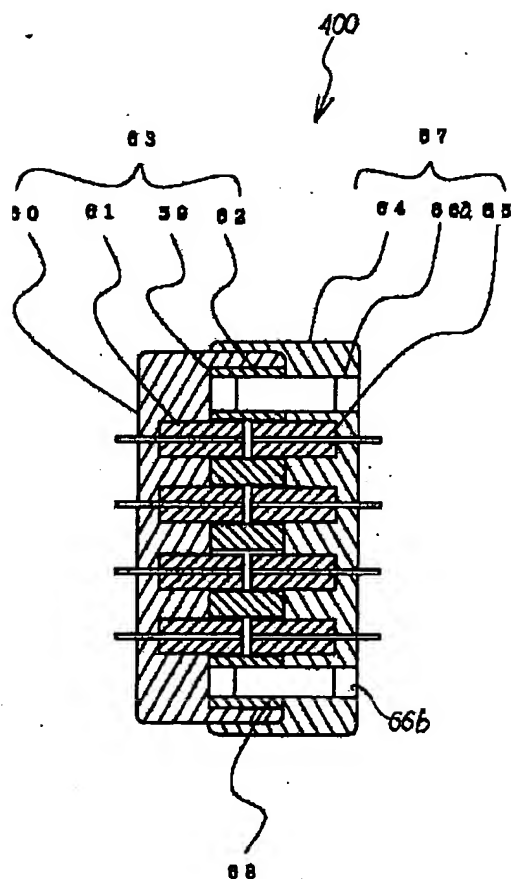
[Drawing 13]



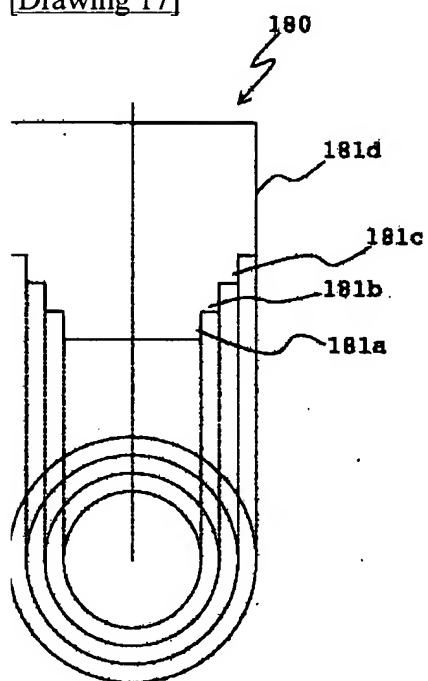
[Drawing 12]



[Drawing 14]

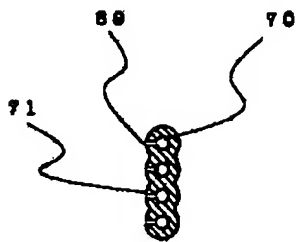


[Drawing 17]

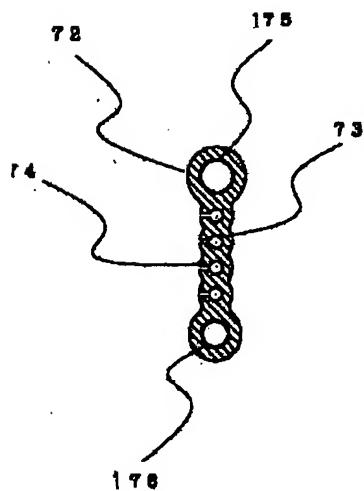


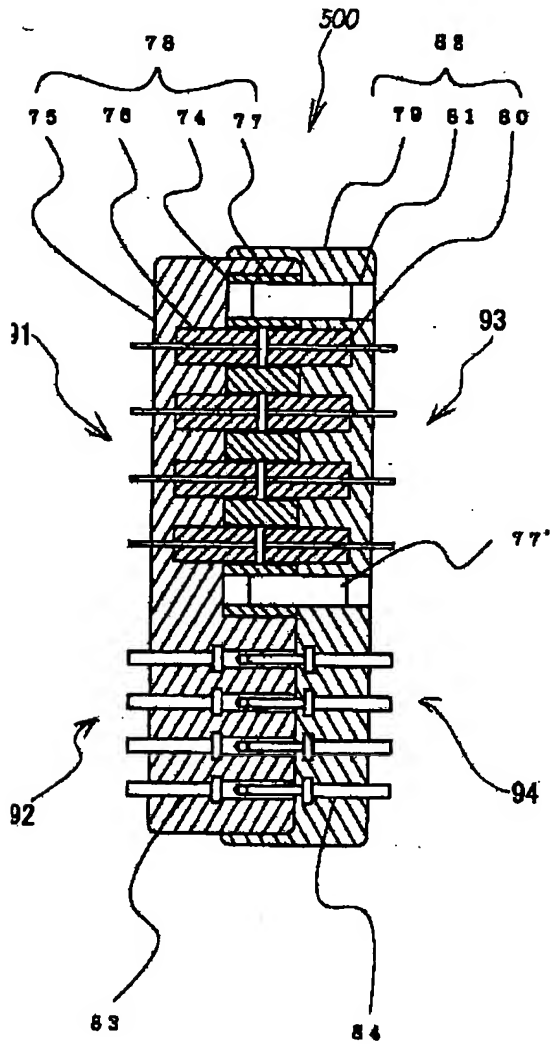
[Drawing 15]

(A)



(B)

[Drawing 16]



[Translation done.]